Appendix F

Hydrological Assessment –
Stormwater Management Study

HYDROGEOLOGIC ASSESSMENT
STORM-WATER MANAGEMENT
GLENMERE PRESERVE
VILLAGE OF FLORIDA, NEW YORK

Prepared For:

Glenmere Preserve

October 2007

Prepared By:

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INTRODUCTION

The Glenmere Preserve Project is a proposed development consisting of single-family semi-attached residences, townhouse residences, multi-family residence buildings, and a clubhouse and pool complex. The project will be serviced by public water and sewer. The following hydrogeologic assessment has been completed to calculate the current ground-water recharge conditions on the site and estimate the change in conditions following build-out of the project.

HYDROGEOLOGIC SETTING

The Glenmere Preserve Project site is located on the east side Route 94 in the Village of Florida, Orange County, New York, and west of Glenmere Lake (figure 1). The 94.96-acre site is mainly wooded with two wetland areas, one on the northwest portion of the site and the second along the southern property boundary. The wetland features encompass approximately 23.54 acres. Topographic elevations on the site range from 474 feet in the wetland area in the northwest corner to 614 feet in the southeast corner of the property.

Ground-water flow typically mimics surface-water flow which indicates ground water at the site generally follows the surface topography, flowing towards the wetland features, then west off the property. A small portion, approximately 7.5 acres on the south side of the property, drains north into Glenmere Lake.

Soils

According to the Soil Survey of Orange County, New York (1981), Erie and Mardin Series compose the majority of the soils beneath the site, with a small area of Nassau Complex-Rock Outcrop along the southern boundary.

The Erie soils, which form in glacial till, are described as gravelly, silt loams that are deep, somewhat poorly drained and contain a fragipan layer between 10 and 24 inches below the surface. Permeability of the soil is described as moderate in the surface layer and slow to very slow in the pan and substratum. Perching of the water table above the fragipan layer occurs during spring and other wet periods. Runoff from the soil is described as medium.

Mardin soils, which also form in glacial till, are described as gravelly, silt loams that are deep, moderately well drained and contain a dense fragipan layer in the lower portion. Permeability of the soil is described as moderate in the surface layer and slow to very slow in the pan and substratum. Perching of the water table above the fragipan layer occurs during spring and other wet periods. Runoff from the soils is described as medium.

The Nassau Complex-Rock Outcrop consists of exposed bedrock (about 50%) and shallow somewhat excessively drained Nassau soils between 10 to 20 inches thick. The Nassau soils form in a thin mantle of glacial till deposits over shale and slate bedrock. Permeability of the Nassau soils is medium, with the water table seldom above the bedrock. In areas of exposed rock, the runoff is rapid.

All of the overburden soil types on the site are glacial till. Glacial till is described as non-sorted, non-stratified sediments deposited by glacial activity. The sediments consist of varying amounts of clay, silt, sand, gravel and boulders. No stratified-drift sand and gravel deposits have been mapped underlying this study property.

Bedrock

The study parcel is underlain by sedimentary bedrock unit known as the Martinsburg Formation (**On** bedrock unit). The Martinsburg Formation consists of the following (Jaffe, 1973):

- Penn Argyl Member-shale (Offield's Snake Hill Member)
- Ramseyburg Member-greywacke and sandstone (Offield's Austin Glen Member)
- Bushkill Member-shale and siltstone-(Offield's Mt. Merino Member)

The Penn Argyl Member consists of dark-gray to grayish-black calcareous shale. The Ramseyburg Member is comprised of greywacke and sandstone. The Bushkill Member consists of dark gray calcareous shale siltstone. This **On** bedrock unit occurs generally in the central region of Orange County.

GROUND-WATER RECHARGE - EXISTING CONDITIONS

Ground-Water Recharge-Average Precipitation

Recharge is generally related to precipitation, but the amount of rainfall which becomes ground-water recharge is difficult to measure directly. In Orange County, the average precipitation is about 43 inches per year (LBG, 2003). About half this amount is lost to evaporation and transpiration processes; the remainder is available to become surface-water run-off and ground-water recharge. Ground-water recharge results from the portion of total rainfall and snowmelt that infiltrates the soil and overburden materials.

Recharge to glacial till overburden is estimated to be approximately 400,000 gpd/sq. mi. (gallons per day per square mile) or approximately 8 inches annually. Therefore, under existing conditions, recharge to the 94.96-acre site is about 59,350 gpd (gallons per day). It should be understood that ground water available at the site is not restricted only to recharge from precipitation falling directly on the site but extends beyond the property boundary to include the watershed area to the site.

Drought Considerations

In addition to evaluating the average recharge conditions, it is important to examine the impact of drought conditions on the site. Historical precipitation data from the Gardnerville, Middletown and Port Jervis rain gauge stations indicate that average precipitation for Orange County is 43 inches. A precipitation probability graph was used to determine the precipitation rate during an extreme drought period, defined as an one-year-in-30 event. Based upon the graph, the extreme drought precipitation rate was 69 percent of the average annual precipitation, or 29.7 inches (LBG, 2003). Based in this data, the recharge estimate under drought conditions for the site is about 40,950 gpd.

GROUND-WATER RECHARGE - BUILD-OUT CONDITIONS

Following the completion of construction, the acreage available for ground-water infiltration will be reduced by the addition of impervious surfaces such as roads, sidewalks and rooftops on the site which total about 23.9 acres. Precipitation run-off from the majority of these impervious surfaces (18.3 acres) will be diverted through a storm-water collection system to onsite storm-water detention ponds and bio-retention facilities; the remainder areas (5.6 acres) will drain without diversion, onto landscaped or natural undisturbed areas. It should be noted, in addition to the direct precipitation which falls on the impervious surfaces subject to storm-water collection, some sheet flow run-off from the landscape at higher topographic setting surrounding the impervious areas, which would normally flow downgradient and off the site, will also be collected.

The majority of the run-off collected in the storm-water detention ponds is retained on the site, with the exception of during storms of a magnitude greater than a one-year flood event when overflow from the ponds will be discharged offsite to prevent flooding. The water collected in the detention ponds infiltrates through the underlying soil into the onsite ground-water system. Because of the increased volume of water captured, as described above, and the increase in holding time of the run-off water in a pond setting, the amount of water which will infiltrate into the onsite ground-water system would likely be more than what would occur under no-build conditions. During periods of no precipitation, water from the pond will continue to infiltrate through the soil, replenishing the ground water beneath the site.

Storm-water run-off which is diverted to the bio-retention areas will be filtered through a soil and rock cover to remove potential pollutants. The majority of the filtered water will then be captured in pipes buried beneath the soil and rock and discharged to one of the onsite wetland features or to an offsite culvert under Route 94.

In total, six bio-retention areas and four storm-water detention ponds are proposed. Summarized in the table below is the area of impervious surface run-off which will be diverted to each facility type. According to the information provided by Lanc and Tully, P.C. (Appendix I), approximately 12.1 acres of imperious surfaces will contribute run-off to the storm-water detention ponds and 6.2 acres of impervious surface run-off will be discharged to the bio-retention areas. Ground-water recharge to the remaining 76.7 acres of the property

including grassy, wooded and wetland areas should remain generally the same as under current conditions.

Under existing conditions, ground-water recharge to the 12.1 acres of areas discharged to the storm-water detention ponds is about 7,565 gpd. As described above, the majority of run-off discharged to the detention ponds will be retained onsite and during heavier rain events, the ponds will retain water that under no-build conditions would be lost by sheet run-off the site. The addition of storm-water detention ponds most likely will result in an increase in the amount of ground-water infiltration into the site's ground-water system by allowing continued infiltration during periods of no precipitation.

Run-off from a total of 6.2 acres of impervious surfaces will be diverted to the onsite bio-retention facilities. Water collected in four of the facilities (3.6 acres of impervious surfaces) will be discharged into the two onsite wetland features and retained in the site's water budget. The run-off from the remaining 2.6 acres will be discharged offsite into culverts under Route 94. Recharge to the 2.6 acres under existing conditions is about 1,625 gpd or about 2.7 percent of the total site recharge. However, although the water collected in the buried pipes will be discharge off the site, the collection of water by the pipes is not 100% efficient; therefore, the net loss will be less than the 2.7 percent calculated above. It should also be noted that the water discharged from these bio-retention areas is discharged off the site but is retained within the regional watershed of the site.

Storm-Water Collection Area	**Number Proposed in Development Plan**	**Acres of Impervious Surfaces Within Collection Areas**	**Recharge to Impervious Areas Under No-Build Conditions (gpd)**
Storm-Water Detention Pond	4	12.1	7,565
Bio-Retention Facility Discharged to Onsite Wetland Feature	4	3.6	2,250
Bio-Retention Facility Discharged to Offsite Culvert	2	2.6	1,625

Potential Water-Quality Impacts

Within the proposed development, the addition of roads and automobile traffic will contribute some hydrocarbons, metallic ions and road salts to the hydraulic system. The majority of this potential impact will be alleviated by good engineering design of catch basins, drainage controls and runoff/infiltration detention structures. The water-quality treatment plan for this proposed project includes significant "control" devices which provide water-quality treatment. These features include four stormwater detention ponds; six bioretention facilities; and additional treatment provided by dry swales and grass swales. The proposed stormwater treatment plan is designed in accordance with New York State Department of Environmental Conservation (NYSDEC) design standards. The stormwater treatment plan will remove all related pollutants to acceptable levels and have minimal impact on regional surface-water and ground-water quality, including the ground-water quality.

Potential Impacts to Residential Well Yields

Residential properties along Glenmere Homesites Road and Orange Road, as well as the accompanying side streets, are currently supplied by individual domestic wells. Concerns regarding the potential impact on the water-level and yield of the wells from the proposed development on the Glenmere Preserve property have been raised. The properties are located to the south and southeast of the Glenmere Preserve parcel (figure 1).

Residential wells in this area of Orange County are typically bedrock wells which withdraw water from the underlying bedrock aquifer. Ground water in the bedrock aquifer is recharged from precipitation which infiltrates through the overburden soils within the regional watersheds. As described above, the engineering design of the storm water collection system, which includes the detection ponds and bio-retention facilities, will minimize the loss of ground-water recharge on the Glenmere Preserve study parcel and the ground-water recharge which is lost from the site (less than 2.7 percent of the total recharge) is retained within the site's major watershed where it remains available to recharge the bedrock aquifer. The amount of overall precipitation recharge to the bedrock aquifer within the watersheds should remain consistent with existing conditions; therefore, no impact to water-levels or yields of residential wells is likely to result.

Also of note, the residential properties along Orange Road and the eastern section of Glenmere Homesites Road are located within the Glenmere Lake watershed which is about 1,552 acres in size. Only 7.5 acres of the 94.96 acre Glenmere Preserve site are also located within this watershed. Even without the engineering controlled for the storm-water run-off, any changes within such a small portion of the watershed would likely go unnoticed.

CONCLUSIONS

The Glenmere Preserve Project is a 94.96-acre site located in the Village of Florida, New York. Soils at the site are mapped as glacial till and the underlying sedimentary bedrock is known as the Martinsburg Formation.

Ground-water recharge from direct precipitation on the site under existing conditions is about 59,350 gpd and under drought conditions 40,950 gpd.

Following construction of the proposed development, run-off from impervious surfaces such as roads, sidewalks and rooftops will be diverted through a storm-water collection system into onsite detention ponds and bio-retention facilities.

Recharge to the 12.1 acres of impervious surfaces which will be drained to the storm-water detention ponds is equal to 7,565 gpd. A majority of this water will be retained onsite in the pond setting resulting in no significant loss to ground-water recharge at the site. Instead, based on the design of the collection system and detention ponds, which also capture the sheet run-off ordinarily lost during heavier rain events, a gain in ground-water recharge may result.

Recharge to the 3.6 acres and 2.6 acres of impervious surfaces which will drain to the bio-retention facilities discharged to onsite wetland features and to offsite culverts are about 2,250 gpd and 1,625 gpd, respectively. The 2,250 gpd will remain onsite and as described above will remain available for onsite recharge. The 1,625 gpd discharged off the site is about 2.7 percent of the site's current total calculated recharge. This amount (about 1,625 gpd) will mostly likely not have a significant effect on the ground-water budget at the site or within the study watershed. Also, the recharge gained from the storm-water detention ponds and the less than 100% efficiency of the buried collection pipes beneath the retention facilities will further minimize the ground water lost from the ground-water budget of the site.

Within the proposed development, the addition of roads and automobile traffic will contribute some hydrocarbons, metallic ions and road salts to the hydraulic system. The majority of this potential impact will be alleviated by good engineering design of catch basins, drainage controls and runoff/infiltration detention structures. The water-quality treatment plan for this proposed project includes significant "control" devices which provide water-quality treatment. These features include four stormwater detention ponds; six bioretention facilities; and additional treatment provided by dry swales and grass swales. The proposed stormwater treatment plan is designed in accordance with New York State Department of Environmental Conservation (NYSDEC) design standards. The stormwater treatment plan will remove all related pollutants to acceptable levels and have minimal impact on regional surface-water and ground-water quality, including the ground-water quality in neighboring residential wells.

The engineering design of the storm water collection system, which includes the detection ponds and bio-retention facilities, has minimized the loss of groundwater recharge on the Glenmere Preserve study parcel and the ground-water recharge which is lost from the site (less than 2.7 percent of the total recharge) is retained within the site's major watershed where it remains available to recharge the bedrock aquifer. The amount of overall precipitation recharge to the bedrock aquifer within the watersheds should remain consistent with existing conditions; therefore, no impact to water-levels or yields of residential wells is likely to result.

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cmm
October 22, 2007
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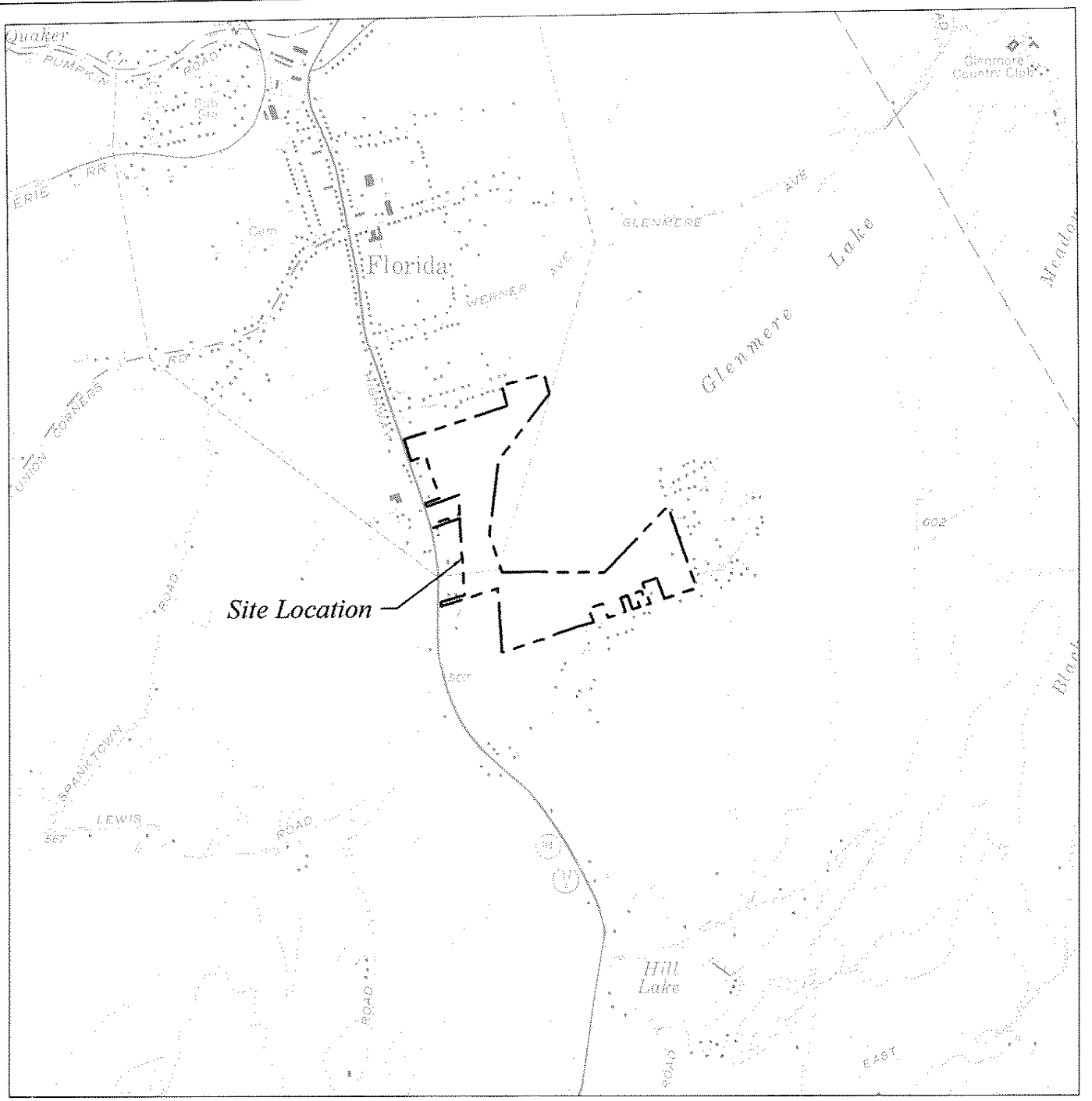
FIGURE



SOURCE: USGS TOPOGRAPHIC QUADRANGLE WARWICK, NEW YORK (PHOTOINSPECTED 1976)

LEGEND

PROPERTY BOUNDARY

QUADRANGLE LOCATION

SCALE IN FEET

GLENMERE PRESERVE
VILLAGE OF FLORIDA, NEW YORK

SITE LOCATION MAP

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APPENDIX I

Glenmere Preserve
Total Drainage Area for On-Site Watersheds

Watersheds Within Site Draining off-site without any retention/ infiltration

Watershed ID	Total Area (ac.)	Impervious Area (ac.)	Pervious Area (ac.)
A3	2.7	1.4	1.3
D1 (Excludes off-site areas)	22.1	2.5	19.6
F2 (Excludes off-site areas)	0.8	0	0.8
F4	2	1	1
G3 (Excludes off-site areas)	20.6	0.3	20.3
H2 (Excludes off-site areas)	4	0	4
H3	0.5	0.4	0.1
Subtotal	52.7	5.6	47.1

Watersheds Within Site Draining to retention/ infiltration facilities (Ponds)

Watershed ID	Total Area (ac.)	Impervious Area (ac.)	Pervious Area (ac.)
B	6.9	1.8	5.1
D2 (Excludes off-site areas)	17.2	6.6	10.6
G2	2.8	1.5	1.3
H1 (Excludes Off-Site Areas)	3.5	2.2	1.3
Subtotal	30.4	12.1	18.3

Watersheds W/in Site Draining to Bioretention Facilities and to wetland/off-site pond to the South

Watershed ID	Total Area (ac.)	Impervious Area (ac.)	Pervious Area (ac.)
D3	1.1	0.4	0.7
E3 (Excludes Off-Site Areas)	4	1.7	2.3
Subtotal	5.1	2.1	3

Watersheds Within Site Draining to Bioretention Facilities and to wetland to the North

Watershed ID	Total Area (ac.)	Impervious Area (ac.)	Pervious Area (ac.)
F1 (Excludes Off-Site Areas)	1.7	0.7	1
G4	0.9	0.8	0.1
Subtotal	2.6	1.5	1.1

Watersheds Within Site Draining to Bioretention Facilities which then discharge and Off-Site to culverts under Rte. 94

Watershed ID	Total Area (ac.)	Impervious Area (ac.)	Pervious Area (ac.)
E2	2.1	1.4	0.7
F3	2.1	1.2	0.9
Subtotal	4.2	2.6	1.6
Totals	**95**	**23.9**	**71.1**